HEATH COMPANY
BENTON HARBOR, MICHIGAN

MODEL **GRA-88-1 AC Power Supply**

HEATHKIT®

ASSEMBLY MANUAL

HEATHKIT

SN 04304
MOUNTED IN HEATH GR 98 RECIEVER
(SN 08240)

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Price $2.00

I-595-1070-03

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Sincerely,

HEATH COMPANY
Benton Harbor, Michigan 49022

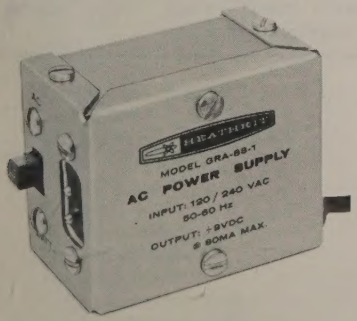
Assembly and Operation

of the

HEATHKIT

AC POWER SUPPLY

MODEL GRA-88-1



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The Heathkit Model GRA-88-1 AC Power Supply enables you to operate Heathkit Models GR-88 or GR-98 from an AC power source. This Power Supply changes the AC line voltage to a constant 9 volts DC. It is also fused, and a dual primary transformer allows you to wire the unit for use from either a 120 VAC or a 240 VAC power line. The AC-BATT (Battery) switch in the Power Supply allows the Receiver to operate either from its internal batteries or from the AC Power Supply when an AC power source is available.

The output voltage of this Power Supply is filtered and well regulated to maintain a constant 9 volts DC. The all solid-state circuitry insures you of many years of trouble-free operation.

Refer to the Kit Builders Guide for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

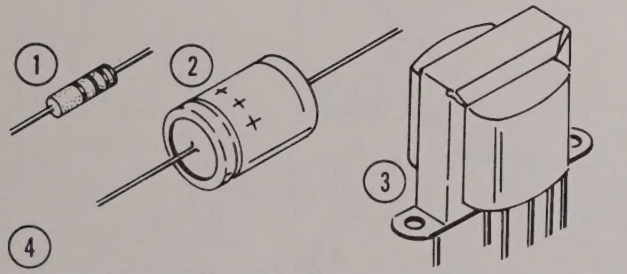
PARTS LIST

Unpack the parts and check them against the following Parts List. The numbers in parentheses are keyed to the numbers on the Parts Pictorial.

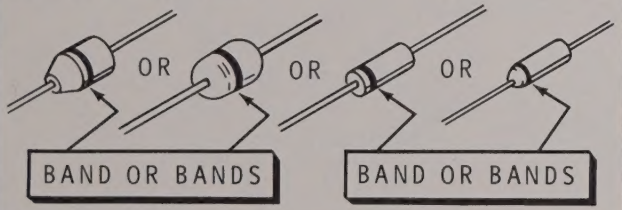
To order replacement parts, refer to the Replacement Parts Price List and use the Parts Order Form furnished with this kit.

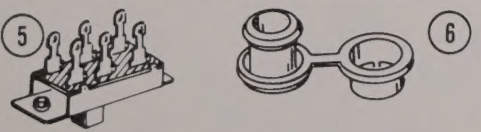
PART No.	PARTS Per Kit	DESCRIPTION
GENERAL		
1-118	1	82 Ω (gray-red-black) 1/2 watt resistor
25-111	1	1000 μF electrolytic capacitor
54-177	1	Power transformer
56-67	1	Zener diode
57-65	1	Silicon diode
60-2	1	Slide switch
73-46	1	Plastic grommet
214-91	1	Chassis
214-92	1	Chassis bottom
417-118	1	2N3393 transistor
421-12	1	1/8 ampere fuse
431-15	1	1-lug terminal strip
431-50	1	1-lug terminal strip
431-49	1	11-lug terminal strip
432-4	1	Line cord connector
490-5	1	Nut starter
597-308	1	Kit Builders Guide
597-260	1	Parts Order Form
General (cont'd.)		
391-34	1	Blue and white label
	1	Manual (see front cover for part number)
		Solder
LINE CORD-WIRE-SLEEVING		
89-3	1	Line cord
344-2	1	Black wire
344-52	1	Red wire
344-56	1	Blue wire
346-1	1	Small sleeving
346-3	1	Large sleeving
HARDWARE		
(16) 250-49	2	3-48 x 1/4" screw
(17) 252-1	2	3-48 nut
(18) 254-7	4	#3 lockwasher
(19) 250-170	4	#6 x 1/4" sheet metal screw
(20) 250-56	6	6-32 x 1/4" screw
(21) 252-3	4	6-32 nut
(22) 254-1	4	#6 lockwasher

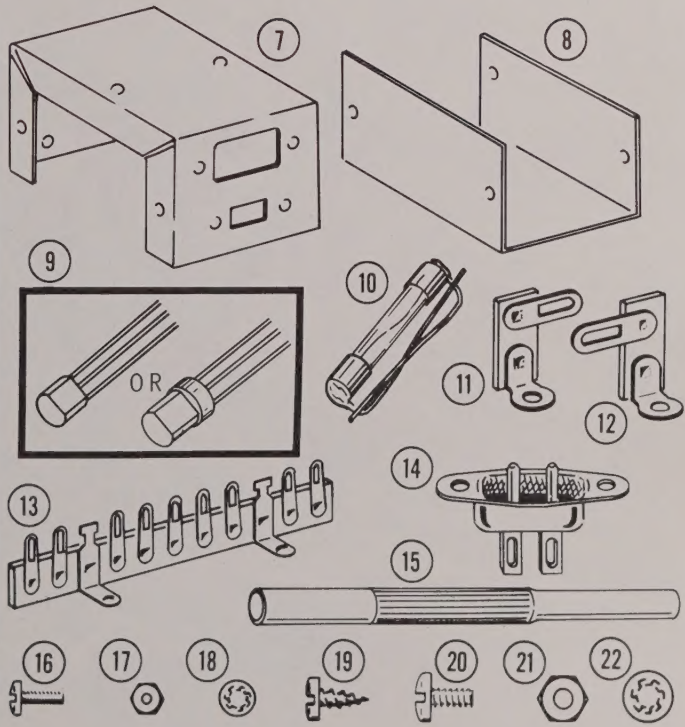
PARTS PICTORIAL

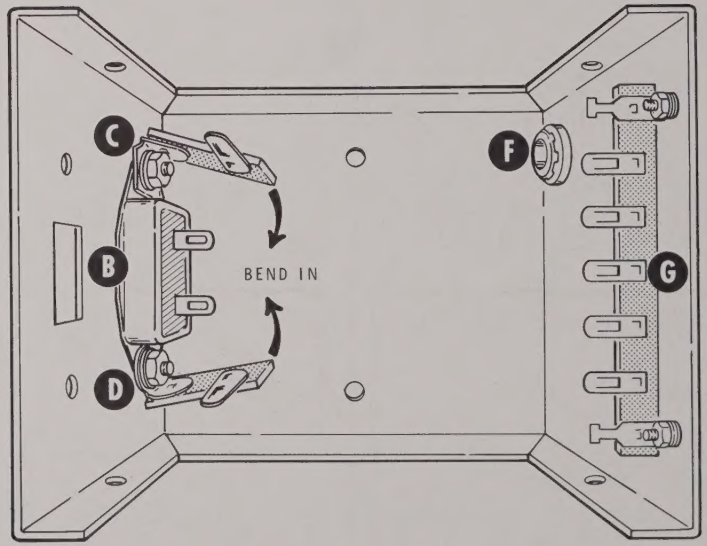


NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES.









PICTORIAL 1

STEP-BY-STEP ASSEMBLY

Before you start to assemble this kit, be sure to read the Kit Builders Guide for complete information on wiring, soldering, and step-by-step assembly procedures.

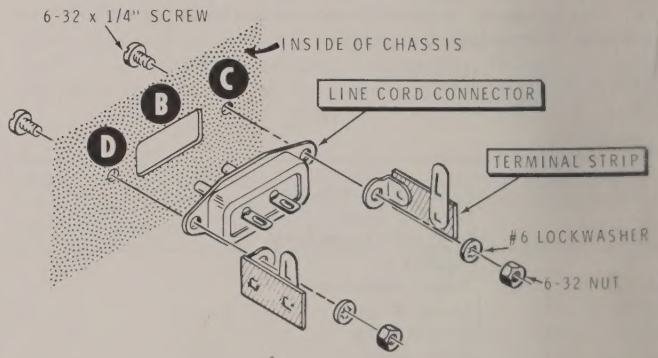
PRELIMINARY PARTS MOUNTING

Refer to Pictorial 1 for the following steps.

( ) Locate the chassis and position it as shown in the Pictorial.

NOTE: The plastic nut starter furnished with the kit can be used to pick up and start 3-48 and 6-32 nuts on screws. You may find the nut starter easier to use if you cut it in half.

( ) Refer to Detail 1A and mount the line cord connector at B with 1-lug terminal strips at C and D. Be sure to install the proper terminal strip at each location. Use 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts. Then bend the terminals strips in slightly as shown.

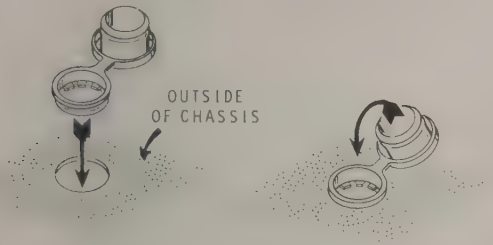


Detail 1A

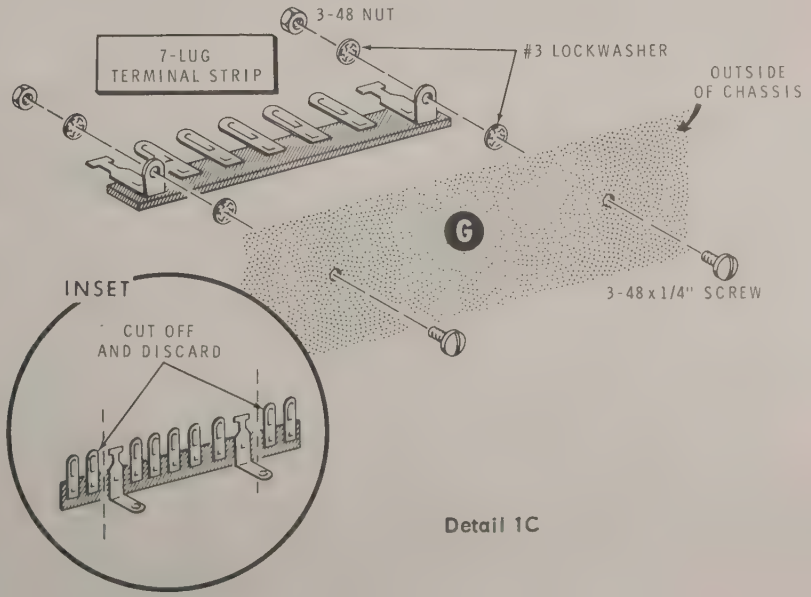
( ) Refer to Detail 1B and mount the plastic grommet in hole F.

( ) Locate the 11-lug terminal strip and cut off both ends as shown in the inset drawing on Detail 1C. These end portions may be discarded.

( ) Refer to Detail 1C and mount the remaining 7-lug portion of this terminal strip at G. Use 3-48 x 1/4" screws, four #3 lockwashers, and 3-48 nuts. Position the terminal strip as shown.


OUTSIDE
OF CHASSIS
POSITION THE SMALL PORTION OF THE GROMMET INTO THE CHASSIS HOLE.
BEND THE LARGE PORTION OF THE GROMMET OVER AND INTO THE SMALL PORTION. PRESS IT FIRMLY INTO PLACE.

Detail 1B



Detail 1C

PRELIMINARY WIRING

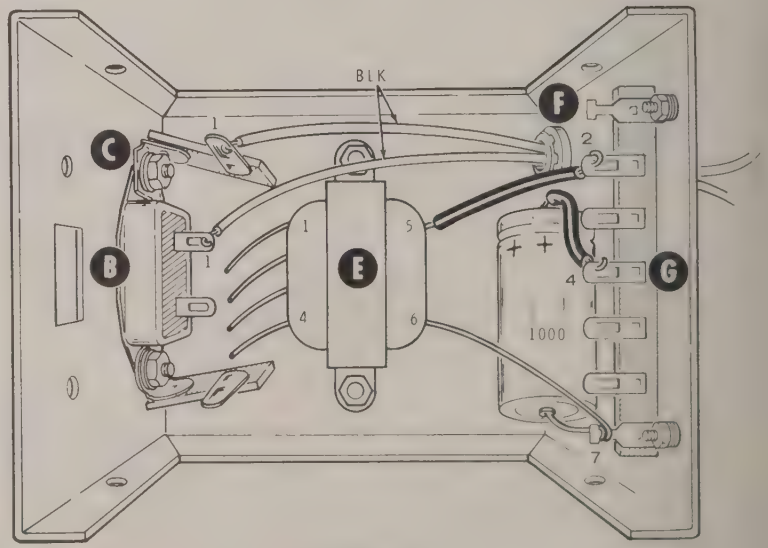
Refer to Pictorial 2 for the following steps.

NOTE: When sleeving is called for in a step, always use the small sleeving unless the large sleeving is specified. Note that there are measuring guides located throughout the Manual that can be used for measuring sleeving and wire.

( ) Place a 1-1/4" length of sleeving on the lead at the positive (+) marked end of the 1000 μF electrolytic capacitor.

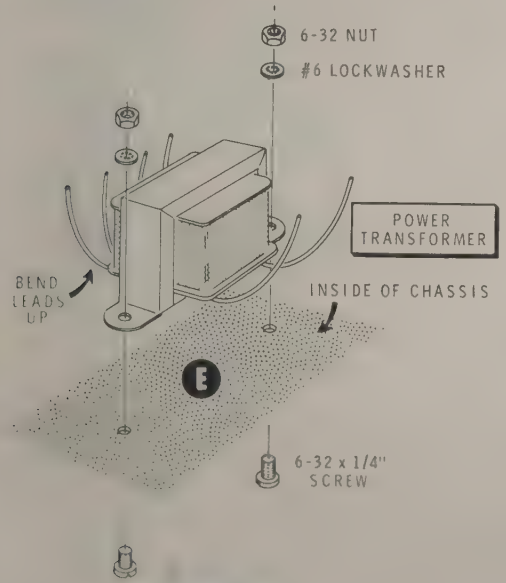
NOTE: The Chassis Photograph on Page 18 shows an actual assembled and wired Power Supply. Refer to this photograph for locations of the parts and correct placement of all wiring.

( ) Connect the positive (+) lead of the capacitor to lug 4 (NS) and the other lead to lug 7 (NS) of terminal strip G. Position the capacitor down in the corner bend of the chassis as shown.



PICTORIAL 2

( ) Locate the power transformer (#54-177) and bend its leads up as shown in Detail 2A.



Detail 2A

( ) Refer to Detail 2A and mount the power transformer at E. Use 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts. Position the transformer as shown in Pictorial 2.

NOTE: When preparing wire, as in the next step, cut the wire to the indicated length and remove 1/4" of insulation from each end. For stranded wire, melt a small amount of solder on each exposed wire end to hold the small wire strands together. The wires are listed in the order in which they will be used.

( ) Prepare the following lengths of hookup wire:

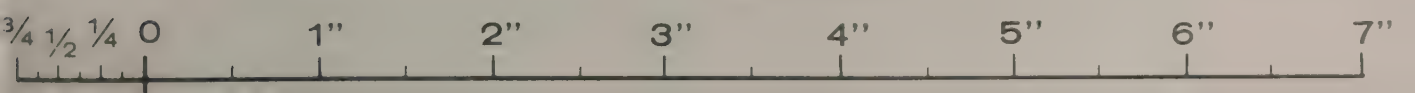
COLOR	LENGTH
Black	18"
Black	18"

( ) Pass one end of an 18" black wire through grommet F and connect to lug 1 of terminal strip C (NS). The other end will be connected later.

( ) Pass one end of the other 18" black wire through grommet F and connect it to lug 1 of line cord connector B (S-1). The other end will be connected later.

( ) Place a 1" length of sleeving on lead 5 of the power transformer. Connect this lead to lug 2 of terminal strip G (NS).

( ) Connect lead 6 of the power transformer to lug 7 of terminal strip G (NS).



ALTERNATE LINE VOLTAGE WIRING

Two sets of line voltage wiring instructions are given below, one for 120 VAC line voltage and the other for 240 VAC line voltage. In the U.S.A., 120 VAC is most often used, while in other countries 240 VAC is more common. USE ONLY THE INSTRUCTIONS THAT AGREE WITH THE LINE VOLTAGE IN YOUR AREA.

120 VAC Wiring

Refer to Detail 2B for the following steps.

Connect the power transformer leads as follows:

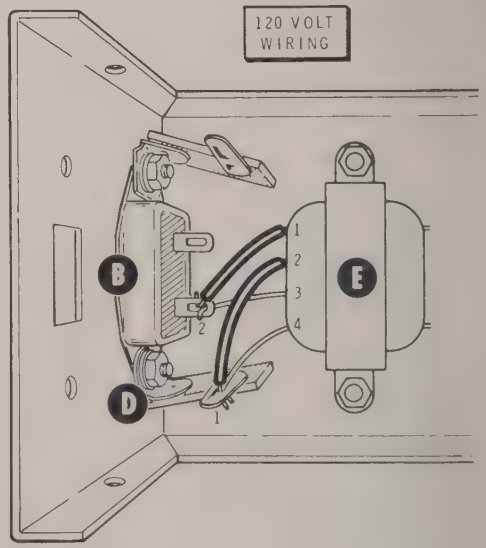
(ˇ) Connect lead 4 to lug 1 of terminal strip D (NS).

(ˇ) Connect lead 3 to lug 2 of line cord connector B (NS).

( ) Place a 1" length of sleeving on lead 2 and connect it to lug 1 of terminal strip D (NS).

( ) Place a 3/4" length of sleeving on lead 1 and connect it to lug 2 of line cord connector B (S-2).

This completes the 120 VAC Wiring. Check to see that none of these four transformer leads touch the chassis. Then proceed to Final Wiring.



Detail 2B

240 VAC Wiring

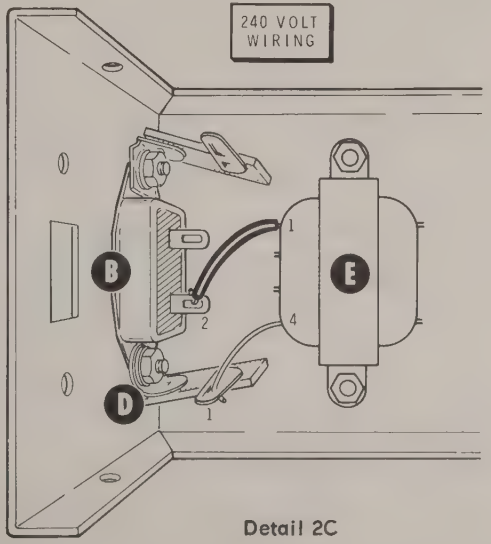
Refer to Detail 2C for the following steps.

Connect the power transformer leads as follows:

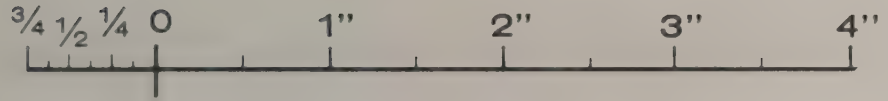
( ) Connect lead 4 to lug 1 of terminal strip D (NS).

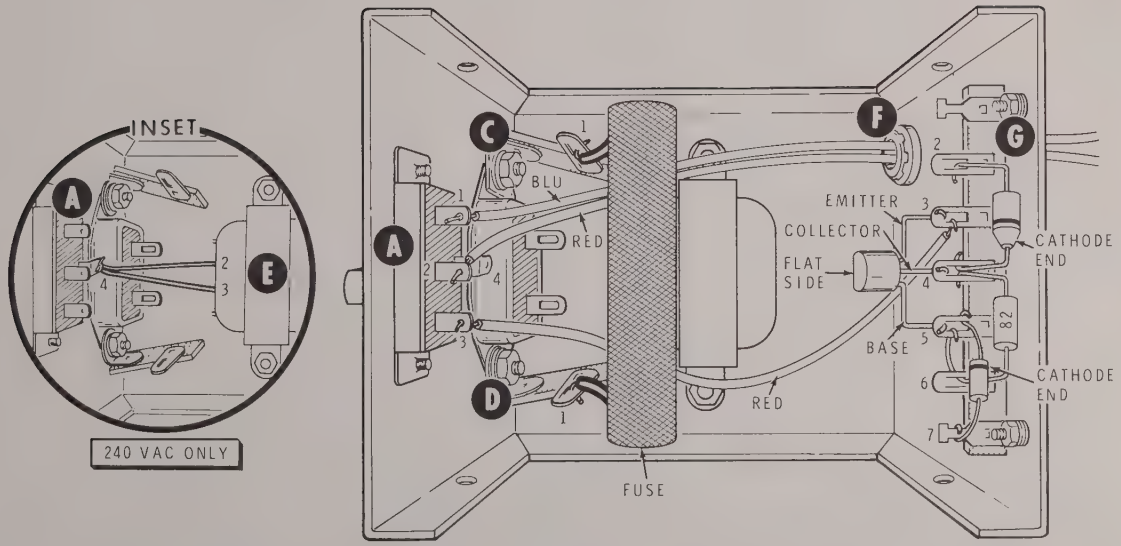
( ) Place a 3/4" length of sleeving on lead 1 and connect it to lug 2 of line cord connector B (S-1).

Leads 2 and 3 of the transformer will be connected later.

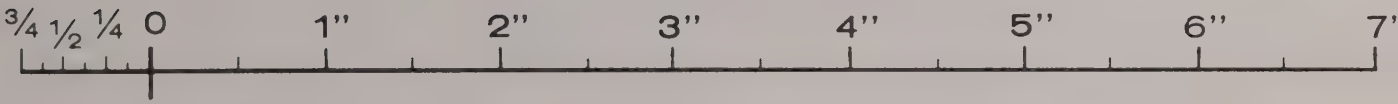


Detail 2C




INSET
A
E
2
3
4
240 VAC ONLY
C
1
BLU
RED
A
1
2
4
3
D
1
FUSE
F
G
2
EMITTER
3
COLLECTOR
FLAT
SIDE
4
CATHODE
END
82
5
BASE
6
CATHODE
END
RED
7

PICTORIAL 3


¾ ½ ¼ 0
1"
2"
3"
4"
5"
6"
7"

FINAL WIRING

Refer to Pictorial 3 for the following steps.

( ) Refer to the inset drawing on Detail 3A, and cut the two indicated lugs from the slide switch.

( ) Bend lug 4 of the slide switch slightly so there is clearance between the switch lug and the transformer.

( ) Refer to Detail 3A and mount the slide switch at A with 6-32 x 1/4" screws. Position the switch as shown.

NOTE: The following two steps should be performed only if the kit is wired for 240 VAC. See the inset drawing on Pictorial 3.

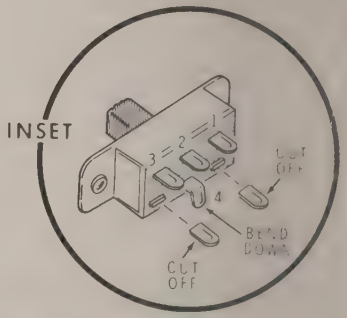
( ) Connect lead 2 of transformer E to lug 4 of switch A (NS).

( ) Connect lead 3 of transformer E to lug 4 of switch A (S-2).

( ) Prepare the following lengths of hookup wire:

COLOR	LENGTH
Blue	12"
Red	18"
Red	3-1/2"

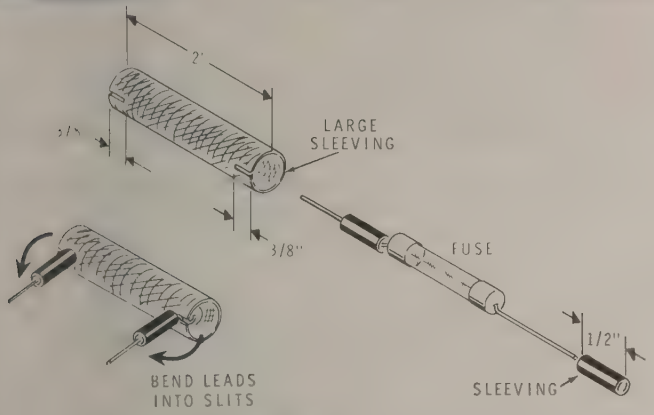
( ) Connect one end of a 12" blue wire to lug 1 of switch A (S-1). Pass the free end of this wire through grommet F for connection later.



Detail 3A

( ) Connect one end of an 18" red wire to lug 2 of switch A (S-1). Pass the free end of this wire through grommet F for connection later.

( ) Connect a 3-1/2" red wire from lug 3 of terminal strip G (NS) to lug 3 of switch A (S-1). Position as shown.



Detail 3B

( ) Refer to Detail 3B and cut a 3/8" long slit in each end of a 2" length of large sleeving.

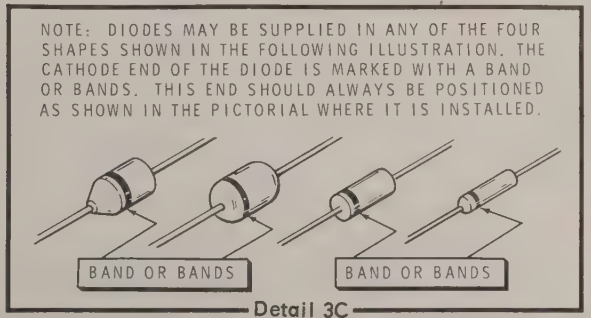
( ) Place a 1/2" length of sleeving on each lead of the fuse. Push the fuse into the length of large sleeving. Then bend the fuse leads down into the slit at each end of the large sleeving as shown.

( ) Connect one lead of the fuse to lug 1 of terminal strip C (S-2). Position the fuse parallel to the transformer as shown.

( ) Connect the other lead of the fuse to lug 1 of terminal strip D (S-3 for 120 VAC wiring) or (S-2 for 240 VAC wiring).

NOTE: Where a wire passes through a connection and then goes to another point, as in the next step, it will count as two wires in the solder instructions (S-2), one entering and one leaving the connection.

( ) Pass one lead of the 82 Ω (gray-red-black) 1/2 watt resistor through lug 6 (S-2) to lug 5 (NS) of terminal strip G. Connect the other lead to lug 4 of the terminal strip (NS). Position the body of the resistor as shown.


NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOUR SHAPES SHOWN IN THE FOLLOWING ILLUSTRATION. THE CATHODE END OF THE DIODE IS MARKED WITH A BAND OR BANDS. THIS END SHOULD ALWAYS BE POSITIONED AS SHOWN IN THE PICTORIAL WHERE IT IS INSTALLED.
BAND OR BANDS
BAND OR BANDS

Detail 3C

NOTE: Diodes will be installed in the next two steps. Refer to Detail 3C to identify the cathode lead of each diode.

( ) Connect the cathode lead of a silicon diode (#57-65) to lug 4 (NS) and the other lead to lug 2 (S-2) of terminal strip G. Position the body of the diode as shown.

( ) Connect the cathode lead of the zener diode (#56-67) to lug 5 (NS) and the other lead to lug 7 (S-3) of terminal strip G.

( ) Refer to Detail 3D and bend the emitter (E) and base (B) leads of the 2N3393 transistor (#417-118) as shown.

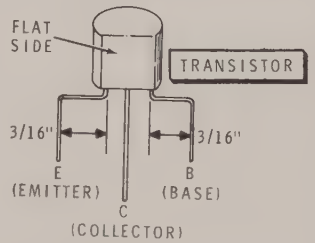
( ) Position the flat side of the transistor body down towards the power transformer as shown in the Pictorial.

Connect the leads of the transistor to terminal strip G as follows:

( ) Emitter (E) lead to lug 3 (S-2).

( ) Collector (C) lead to lug 4 (S-4).

( ) Base (B) lead to lug 5 (S-3).



Detail 3D

This completes the wiring of the Power Supply. Check the wiring carefully to be sure that no errors were made, especially in the installation ot the electrolytic capacitor, transistor, and diodes. Be sure all connections are soldered. Shake out any wire clippings or solder splashes.

TEST

Use the following steps to check out the Power Supply before installing it in the Receiver. NOTE: A DC voltmeter is required. If this instrument is not available, proceed to Final Assembly.

( ) Twist together the bare ends of the two black wires coming out from the grommet of the Power Supply. Tape this connection for the following steps.

( ) Connect the positive test probe of the voltmeter to the red lead of the Power Supply. Connect the voltmeter common lead to the Power Supply chassis.

( ) With the Power Supply switch in the BATT position, connect the line cord to the Power Supply.

( ) Plug the line cord into an AC outlet.

( ) Place the Power Supply switch in the AC position. The voltmeter should indicate 9 volts DC. If it does not indicate 9 volts DC, or very nearly 9 volts DC, refer to the In Case Of Difficulty section of this Manual.

FINAL ASSEMBLY

Refer to Pictorial 4 for the following steps.

NOTE: In the next step, be careful that you do not pinch any of the wires between the chassis and the chassis bottom.

( ) Position the chassis as shown and slide the chassis bottom into the chassis. Secure the chassis bottom with #6 x 1/4" sheet metal screws in the two indicated chassis holes. The two remaining #6 x 1/4" sheet metal screws will be used later to install the Power Supply into the Receiver.

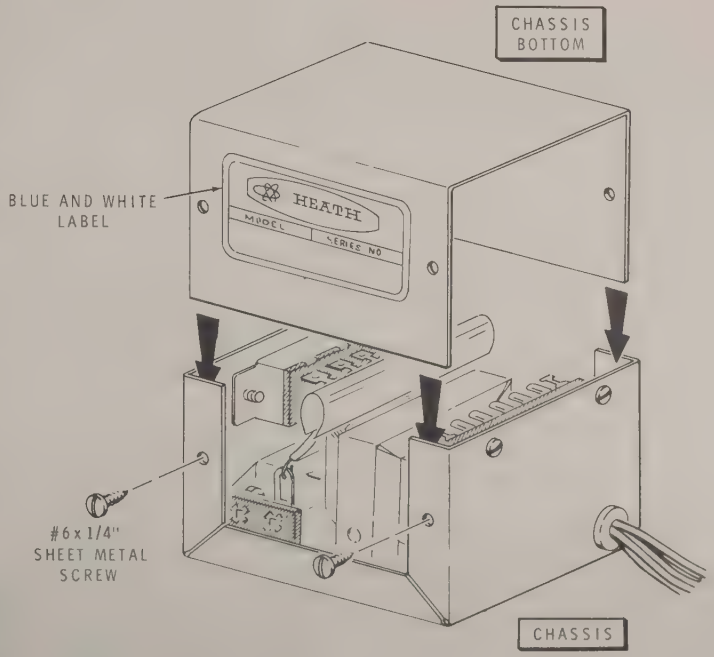
NOTE: The blue and white label that is installed in the next step shows the Model number and Production Series number of your kit. Use these numbers in any communications with the Heath Company this assures you that you will receive the most complete and up-to-date information in return.

( ) Carefully peel away the protective backing paper from the blue and white label. Then press the label in place on the Power Supply at the indicated location.

This completes the Final Assembly. Be sure to fill out and return your Registration Card.

You should now install the Power Supply in your GR-88 or GR-98 Receiver. Use the installation instructions given in the Receiver Manual. Should any difficulties occur with the operation of the Power Supply, refer to the In Case Of Difficulty section of this Manual.

Be sure to read the following Operation section before placing the Power Supply in operation.



PICTORIAL 4

OPERATION

Once the Power Supply is installed in your Receiver, it operates very simply. For battery operation, place the AC-BATT switch on the Power Supply in the BATT position. Then use the ON-OFF switch of the Receiver to turn the Receiver on and off.

To operate the Receiver from the AC line, place the AC-BATT switch in the AC position. Then plug the line cord into the Power Supply and an AC outlet. The OFF-ON switch of the Receiver will turn both the Power Supply and the Receiver off and on.

IN CASE OF DIFFICULTY

The following information deals with the types of difficulties that could show up right after the kit is assembled. These difficulties are most likely to be caused by assembly errors or faulty soldering. Refer to the following steps and also to the Troubleshooting Chart, which lists some specific difficulties with the possible causes.

1. Recheck the wiring. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the builder.

2. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure they are soldered as described in the Soldering section of the Kit Builders Guide.

3. Check to see that all parts have been installed properly, especially the diodes, transistor, and electrolytic capacitor.

4. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

5. If, after careful checks, the trouble is still not located and a voltmeter is available, check voltage readings against those shown on the Schematic Diagram. All voltage readings were taken with a high impedance input voltmeter. Voltages may vary as much as ±20%.

6. A review of the Circuit Description and Schematic may also help you to locate any difficulties in the kit. Refer to the Chassis Photograph for help in locating parts.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the Service and Warranty section of the "Kit Builders Guide", and to the "Factory Repair Service" information on fold-out from Page 18 of this Manual.

Troubleshooting Chart

DIFFICULTY	POSSIBLE CAUSE
1. Completely inoperative.	A. Line cord not plugged in. B. AC-BATT switch in BATT position with no batteries installed. C. Blown fuse. D. AC-BATT switch improperly wired. E. Leads 1 through 6 of power transformer improperly connected or shorting to chassis. F. Blue and red leads shorted to the chassis.
2. No DC voltage output.	A. AC-BATT switch in BATT position. B. AC-BATT switch improperly wired. C. Diode D1 installed backwards. D. Transistor Q1. E. Leads 5 and 6 of power trasformer incorrectly wired, or lead 5 touching the chassis. F. Blue and red leads shorted to the chassis.
3. Output voltage not regulated.	A. Transistor Q1 installed improperly or defective. B. Diode D2. C. Resistor R1.
4. Excessive 60 Hz hum.	A. Capacitor C1 installed incorrectly or defective.
5. Intermittent operation.	A. Poor solder connection. B. Intermittent switch. C. Line cord making poor contact.

SPECIFICATIONS

Input Voltage	120 or 240 VAC at 50/60 Hz.
Input Power Requirements	2.5 watts at 120 VAC or 1.25 watts at 240 VAC.
Output Voltage	9 volts DC nominal.
Regulation	0 to 80 mA ±6% from 10 degrees F to 122 degrees F.
Output Current	80 mA maximum.
Duty Cycle	Continuous.
Ripple	Less than 1% at 80 mA.
Dimensions	2-3/8" wide x 3-1/8" long x 1-1/2" high.
Net Weight	10 ounces.

The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

CIRCUIT DESCRIPTION

Refer to the Schematic (fold-out from Page 17) when reading the Circuit Description.

The AC line voltage (either 120 volts or 240 volts, depending on how the kit is wired) is fed to the primary windings of transformer T1. The stepped-down voltage from the secondary winding of T1 is rectified by diode D1 and filtered by capacitor C1.

Transistor Q1 is a series regulator which keeps the output DC voltage at a constant level over varying current changes. Resistor R1 provides bias for zener diode D2 and the base of Q1, D2 holds this bias voltage at a constant 8.5 volts.

The output voltage from the emitter of Q1 is connected through the AC-BATT switch to the Receiver. When the Receiver is operated on its internal batteries, the switch disconnects the Power Supply and connects the batteries to the Receiver.

With the AC-BATT switch in the AC position, the transformer isolates the chassis of the Power Supply from the AC line, preventing a possible shock hazard. This complies with UL Approved power supply circuits.

FACTORY REPAIR SERVICE

You can return your completed kit to the Heath Company Service Department to have it repaired for a minimum service fee. (Kits that have been modified will not be accepted for repair.) Or, if you wish, you can deliver your kit to a nearby Heathkit Electronic Center. These centers are listed in your Heathkit catalog. NOTE: Do not include wooden cabinets, which are easily damaged in shipment, when returning equipment for service.

To be eligible for replacement parts under the terms of the warranty, equipment returned for factory repair service, or delivered to a Heathkit Electronic Center, must be accompanied by the invoice or the sales slip, or a copy of either. If you send the original invoice or sales slip, it will be returned to you.

If it is not convenient to deliver your kit to a Heathkit Electronic Center, please ship it to the factory at Benton Harbor, Michigan and observe the following shipping instructions:

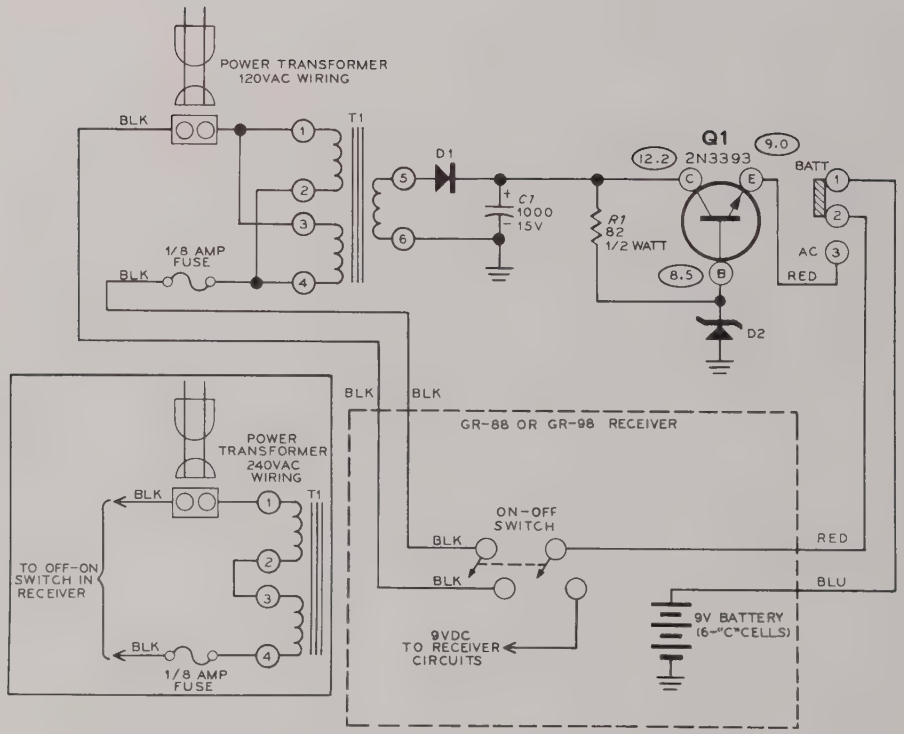
Prepare a letter in duplicate, containing the following information:

- Your name and return address.
- Date of purchase.
- A brief description of the difficulty.
- The invoice or sales slip, or a copy of either.
- Your authorization to ship the repaired unit back to you C.O.D. for the service and shipping charges, plus the cost of parts not covered by the warranty.

Attach the envelope containing one copy of this letter directly to the unit before packaging, so that we do not overlook this important information. Send the second copy of the letter by separate mail to Heath Company, Attention: Service Department, Benton Harbor, Michigan 49022.

Check the equipment to see that all parts and screws are in place. Then, wrap the equipment in heavy paper. Place the equipment in a strong carton, and put at least THREE INCHES of resilient packing material (shredded paper, excelsior, etc.) on all sides, between the equipment and the carton. Seal the carton with gummed paper tape, and tie it with a strong cord. Ship it by prepaid express, United Parcel Service, or insured parcel post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

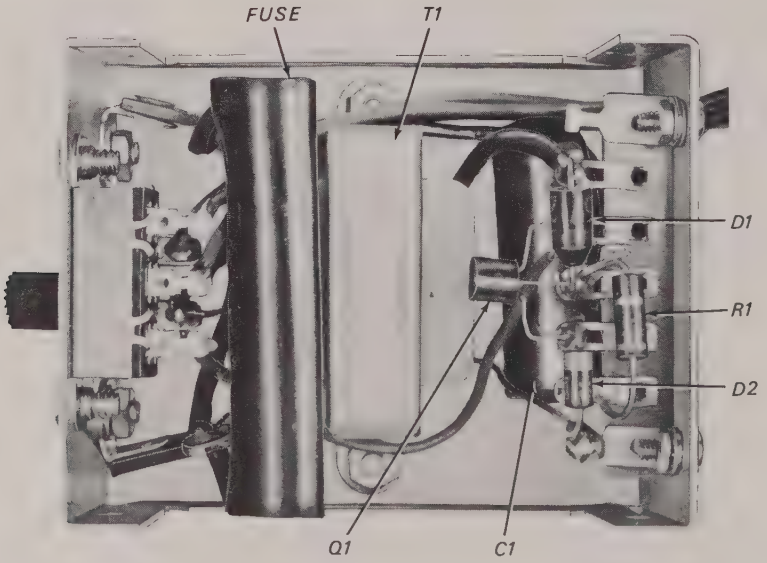


SCHEMATIC OF THE HEATHKIT® AC POWER SUPPLY MODEL GRA-88-1

NOTES:

1. ⬭ THIS SYMBOL INDICATES A POSITIVE DC VOLTAGE MEASUREMENT THAT WAS TAKEN WITH A HIGH IMPEDANCE INPUT VOLTMETER FROM THE POINT INDICATED TO CHASSIS GROUND.
2. REFER TO THE CHASSIS PHOTO FOR THE PHYSICAL LOCATION OF PARTS.

CHASSIS PHOTOGRAPH



REPLACEMENT PARTS PRICE LIST

To order parts, use the Parts Order Form furnished with this kit. If Parts Order Form is not available, refer to Replacement Parts in the Kit Builders Guide.

PART No.	PRICE Each	DESCRIPTION
GENERAL		
1-118	.10	82 Ω 1/2 watt resistor
25-111	2.35	1000 μF electrolytic capacitor
54-177	2.35	Power transformer
56-67	1.10	Zener diode
57-65	.20	Silicon diode
60-2	.30	Slide switch
73-46	.10	Plastic grommet
214-91	.35	Chassis
214-92	.15	Chassis bottom
417-118	.40	2N3393 transistor
421-12	.30	1/8 ampere fuse
431-15	.10	1-lug terminal strip
431-50	.10	1-lug terminal strip
431-49	.15	11-lug terminal strip
432-4	.10	Line cord connector
331-6	.15	Solder
490-5	.10	Nut starter
	2.00	Manual (see front cover for part number)

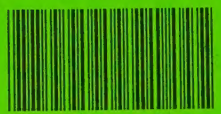
PART No.	PRICE Each	DESCRIPTION
LINE CORD-WIRE-SLEEVING		
89-3	.60	Line cord
344-2	.05/ft	Black stranded wire
344-52	.05/ft	Red hookup wire
344-56	.05/ft	Blue hookup wire
346-1	.05/ft	Small sleeving
346-3	.05/ft	Large sleeving
HARDWARE		
250-49	.05	3-48 x 1/4" screw
252-1	.05	3-48 nut
254-7	.05	#3 lockwasher
250-170	.05	#6 x 1/4" sheet metal screw
250-56	.05	6-32 x 1/4" screw
252-3	.05	6-32 nut
254-1	.05	#6 lockwasher

The above prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering from a Heathkit Electronic Center to cover local sales tax, postage, and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties, and rates of exchange.

HEATH

Schlumberger

MP MASTER



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THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

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